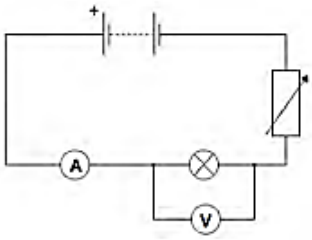
Electricity GCSE AQA Higher Physics Past Papers Answers

01.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	V = 0.10 x 45 4.5 (V)		1 1	AO2/1 4.2.2 4.2.1.3
2	R = 12 / 0.10 total resistance = 120 (Ω) R = 120 – 105 = 15 (Ω)		1 1 1	AO2/1 4.2.2 4.2.1.3
3	(total) resistance decreases (so) current increases		1 1	AO1/2 4.2.2 4.2.1.3
Total			**7**	

02.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1		battery in series with bulb and ammeter	1	AO1/2 4.2.1.1/3 WS2.2
		voltmeter in parallel with bulb	1	
		variable resistor	1	
		or variable power pack **or** potentiometer		
2	A is brighter because it has a higher current (than lamp B at any p.d.)		1	AO3/1a
	(therefore A has a) higher power output (than bulb B)	accept higher energy output per second	1	AO1/1 4.2.4.1/3
3	lower current (than lamp A) for the same potential difference	accept answer in terms of R = V/I	1	AO1/1
	lower gradient (than lamp A)		1	AO2/2 4.2.1.3/4
4	0 – 2 Volts	allow a range from 0 V up to any value between 1 and 2 V.	1	AO3/2b 4.2.1.3/4
	(for an ohmic conductor) current is directly proportional to potential difference	allow lines (of best fit) are straight and pass through the origin	1	
	(so) resistance is constant		1	
Total			**10**	

03.

Question	Answers	Extra information	Mark	AO/ Spec. Ref
03.1	ammeter and voltmeter symbols correct voltmeter in parallel with wire ammeter in series with wire		1 1 1	AO1 4.2.1.1 4.2.1.3
03.2	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	AO1 4.2.1.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.		3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2	
	No relevant content		0	
	Indicative content: • length measured • length varied • current measured • potential difference measured • repeat readings • calculate resistance for each length • resistance = $\frac{\text{potential difference}}{\text{current}}$ • plot a graph of resistance against length • hazard: high current • may cause wire to melt / overheat • may cause burns (to skin) • use low currents			

Question	Answers	Extra information	Mark	AO/ Spec. Ref
03.3	the temperature of the wire would not change		1	AO3 4.2.1.3
03.4	the accuracy of the student's results would be higher		1	AO3 4.2.1.3
	the resolution of the length measurement would be higher		1	
Total			12	

04.

Question	Answers	Extra information	Mark	AO/ Spec. Ref
1		in this order only		AO1 4.2.1.4
	potential difference	allow p.d. allow voltage	1	
	temperature		1	
2	the current increases (when the potential difference increases)		1	AO1 4.2.1.4
	(which) causes the temperature of the filament to increase		1	
	(so) the resistance increases	do **not** accept resistance increases and then levels off	1	
3	a higher proportion / percentage of the (total) power / energy input is usefully transferred **or** higher (useful) power / energy output for the same (total) power / energy input	wastes less energy is insufficient	1	AO2 4.1.2.2
4	potential difference increases		1	AO2 4.2.2
	current decreases		1	AO1 4.2.2
5	1000 (Ω)	reason only scores if R =1000 (Ω)	1	AO2 4.2.1.3
	potential difference is shared in proportion to the resistance	allow a justification using a correct calculation	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref
6		an answer of 1.7×10^{-3} (A) scores **4** marks		AO2 4.2.1.3
	$12 = I \times 7000$		1	
	$I = \frac{12}{7000}$		1	
	$I = 1.71 \times 10^{-3}$ (A)	an answer that rounds to 1.7×10^{-3} (A) scores **3** marks	1	
	$I = 1.7 \times 10^{-3}$ (A) **or** $I = 0.0017$ (A)	this answer only	1	
		an answer of 2.4×10^{-3} (A) scores **2** marks		
		if no other marks scored allow **1** mark for calculation of total resistance (7000 Ω)		
Total			**14**	

05.

Question	Answers	Extra information	Mark	AO/ Spec. Ref
1	risk of electric shock (if someone touched the case)	allow risk of electrocution (if someone touched the case)	1	AO1 4.2.3.2
2		an answer of 11 (A) scores **3** marks		AO2 4.2.4.1
	$2530 = I \times 230$	this mark may be awarded if P is incorrectly / not converted	1	
	$I = \frac{2530}{230}$	this mark may be awarded if P is incorrectly / not converted	1	
	$I = 11$ (A)	this answer only	1	
		an answer of 0.011 (A) scores **2** marks		
3		an answer of 0.12 (kg) **or** an answer that rounds to 0.12 (kg) scores **5** marks		AO2 4.2.4.2 4.1.1.3
	$E = 2530 \times 14$	this mark may be awarded if P is incorrectly / not converted	1	
	$E = 35\,420$ (J)	this answer only	1	
	$35\,420 = m \times 4200 \times 70$	allow their calculated E = $m \times 4200 \times 70$	1	
	$m = \frac{35\,420}{4200 \times 70}$	allow $m = \frac{\text{their calculated E}}{4200 \times 70}$	1	
	$m = 0.12$ (kg)	allow an answer that is consistent with their calculated value of E	1	
Total			**9**	

06.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	The energy transferred each second to the bulb.		1	4.1.1.4 AO1
2	power = potential difference × current **or** $P = VI$		1	4.2.4.1 AO1
3	$40 = I \times 230$ $I = \frac{40}{230}$ $I = 0.17$ (A)	an answer of 0.17 (A) scores **3** marks a correct answer that rounds to 0.17 (A) scores **3** marks	1 1 1	4.2.4.1 AO2
4	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	4.1.2.2 AO1
5	$0.30 = \frac{\text{useful power output}}{9.0}$ useful power output = 0.30×9.0 useful power output = 2.7 (W)	an answer of 2.7 (W) scores **3** marks	1 1 1	4.1.2.2 AO2
6	bulbs also transfer thermal energy the efficiency of the light bulb also needs to be considered	allow light bulbs emit infrared radiation as well as visible light ignore so people know how bright the bulb is allow the cost to power the light bulb depends on the efficiency allow to see how much energy is wasted	1 1	4.1.2.2 4.1.1.4 AO1 AO3
Total			**11**	

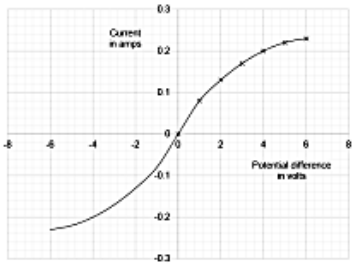
07.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	electric car journey will take a (much) longer time	allow diesel car journey will take a shorter time	1	4.1.3 AO3
	(because) battery will need recharging **or** (because) the car will need to stop for 40 minutes	allow diesel car will not need to be refuelled	1	
2	energy stored in diesel = 45 × 51 = 2295 (MJ)		1	4.1.3 1AO1 1AO2
	energy stored in batteries = 0.95 × 280 = 266 (MJ)		1	1AO3
	(so) the diesel stores more energy than the battery (and the diesel car has a higher range)	this mark is dependent on correct calculations of energy stored	1	
3	any **2** from: • recharging is a continuous process	allow cars do not need to stop to recharge allow shorter journey times allow don't have to wait for battery to recharge allow longer time between recharges allow the range of the electric car is increased	2	4.1.3 AO1
	• fewer cells needed in the car	allow smaller battery needed in the car		
	• more cars can be charged at the same time	allow do not need to find a charging point allow fewer charging stations needed ignore it is quicker ignore cost of charging ignore methods of electricity generation		
4	when cars are plugged in		1	4.1.3 AO1
	the energy from car batteries could be transferred back to the National Grid	allow mains supply for National Grid allow energy from car batteries could be used to power household appliances	1	
Total			**9**	

08.

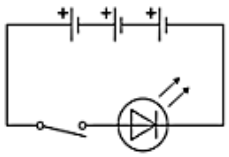
Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	50		1	4.2.3.1 AO1
	Hz / hertz	allow Hertz	1	
2	(both) switches need to be closed / on		1	4.2.2 AO1
	to complete the series circuit **or** to allow charge to flow **or** so there is a current in the circuit		1	
3		an answer of 7.5 (A) scores **3** marks an answer of 0.237(A) scores **2** marks		4.2.4.1 AO2
	$1800 = I^2 \times 32$	this mark may be awarded if P is incorrectly or not converted	1	
	$I^2 = \frac{1800}{32}$ **or** $I^2 = 56.25$	this mark may be awarded if P is incorrectly or not converted	1	
	$I = 7.5$ (A)	this answer only	1	
4		an answer of 300 (s) scores **3** marks an answer of 300 000 (s) scores **2** marks		4.1.1.4 AO2
	$1500 = \frac{450\,000}{t}$	this mark may be awarded if P is incorrectly or not converted	1	
	$t = \frac{450\,000}{1500}$	this mark may be awarded if P is incorrectly or not converted	1	
	$t = 300$ (s)	this answer only	1	
Total			**10**	

09.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	ammeter and voltmeter symbols correct voltmeter in parallel with lamp ammeter in series with lamp		1 1 1	AO1 4.2.1.1 RPA 4
2	smooth curved line of correct shape passing through - 4.0 V, - 0.2 A ***or*** *– 6.0 V, - 0.23 A*  	do not accept a line that becomes horizontal 2nd mark conditional on scoring 1st mark	1 1	AO2 4.2.1.4 RPA 4
3	potential difference = current × resistance **or** *V = IR*		1	AO1 4.2.1.3 RPA 4
4	I = 0.08 (A) 1.0 = 0.08 × R $R = \frac{1.0}{0.08}$ R = 12.5 (Ω)	 allow 1.0 = their I × R provided their I has been obtained from the graph allow $R = \frac{1.0}{\text{their I}}$ allow an answer consistent with their I	1 1 1 1	AO2 4.2.1.3 RPA 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5	ammeter displays a reading when not connected (to a circuit)		1	AO3 4.2.1.4 RPA 4
Total			**11**	

10.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1			1	AO1 4.2.1.1
2	charge flow = current × time **or** $Q = It$		1	AO1 4.2.1.2
3	I = 0.050 (A)		1	AO2 4.2.1.2
	Q = 0.050 × 14 400	allow a correct substitution using an incorrectly/not converted value of I	1	
	Q = 720 (C)	allow a correct calculation using an incorrectly/not converted value of I	1	
4	there is no current in a diode (in the reverse direction) **or** charge will not flow through a diode (in the reverse direction)	allow diode will not conduct (electric charge) do not accept the circuit is not complete	1	AO1 4.2.1.4 4.2.1.3
	(because) a diode has a (very) high resistance (in the reverse direction)		1	
5	Efficiency = $\frac{\text{Useful power output}}{\text{Total power input}}$		1	AO1 4.1.2.2
6	$0.75 = \frac{\text{Useful power output}}{0.24}$		1	AO2 4.1.2.2
	Useful power output = 0.75 × 0.24		1	
	Useful power output = 0.18 (W)		1	
Total			**11**	

11.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	$15.7 = \frac{15.8 + 15.3 + X}{3}$ **X** = 16.0 (Ω)		1 1	AO2 4.2.1.3 RPA 3
2	precise results show little variation the 4th result was further away from the mean than the other values	 allow the range of values has increased ignore the 4th result was an anomaly	1 1	AO3 4.2.1.3 RPA 3
3	two pairs of values of n and R showing that $n \times R$ = constant third pair of values of n and R showing that $n \times R$ = constant (so) $n \times R$ = constant (showing the student was correct)	eg 2 × 24 = 48, 3 × 16 = 48 4 × 12 = 48, 5 × 9.5 = 47.5 6 × 8 =48 allow 1 mark each for two statements relating the change in number of resistors to the change in (mean total) resistance allow 1 mark for use of data from graph to confirm at least one statement	1 1 1	AO3 4.2.1.3 RPA 3
4	multiple paths for charge / electrons to flow total current is greater (for the same potential difference when more resistors are added)	allow current for charge	1 1	AO1 4.2.1.3 RPA 3
Total			**9**	

12.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	$5.75 = I \times 230$		1	AO2 4.2.4.1 4.2.1.3
	$I = \frac{5.75}{230}$		1	
	$I = 0.025$ (A)		1	
	$230 = 0.025 \times R$ or $R = \frac{230}{0.025}$	allow a correct substitution using an incorrect value of I or allow a correct rearrangement using incorrect value of I	1	
	$R = 9200$ (Ω)	allow a correct calculation of resistance using an incorrect value of I	1	
		alternative approach for 4th and 5th marks: $5.75 = 0.025^2 \times R$ (1) or $R = \frac{5.75}{0.025^2}$ $R = 9200$ (Ω) (1)		
		alternative approach: $5.75 = \frac{230^2}{R}$ (3) $R = \frac{230^2}{5.75}$ (1) $R = 9200$ (Ω) (1)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	one wire in the switch is live	allow the switch / circuit is live allow one wire is at a potential of 230 V	1	AO1 4.2.3.2
	the electrician is earthed **or** the electrician is at earth potential		1	
	(so) there will be a (large) potential difference between the live wire and the electrician / earth (if the electrician touched the wire)		1	
3	50 Hz has the lowest (maximum) let-go current		1	AO3 4.2.3.1
	a higher / lower / different frequency would allow people to let go at a greater current	allow a specific numerical example as opposed to a trend	1	
Total			**10**	

13.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	the polarity (of the supply) does not change	allow potential difference in one direction (only)	1	AO1 4.2.3.1
2	energy transferred = power × time		1	AO1 4.1.1.4 4.2.4.2
3	162 000 000 = 7200 × t $t = \frac{162\,000\,000}{7200}$ t = 22 500 (s)		1 1 1	AO2 4.1.1.4 4.2.4.2
4	$V = I \times R$		1	AO1 4.2.1.3
5	480 = 15 × R $R = \frac{480}{15}$ R = 32 (Ω)		1 1 1	AO2 4.2.1.3
6	time taken using system **A** is double the time of system **B**		1	AO3 4.2.4.1
Total			**10**	

14.

Question	Answers		Mark	AO/ Spec. Ref
1	**Level 3**: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	AO1 4.2.1.4 RPA4
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.		3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2	
	No relevant content		0	
	Indicative content • measure the current in **R** using the ammeter • measure the p.d. across **R** using the voltmeter • vary the resistance of the variable resistor (or vary the number of cells or use a variable power supply) • record a range of values of current and p.d. • ensure current is low to avoid temperature increase • switch circuit off between readings • reverse connection of **R** to power supply • repeat measurements of I and V in negative direction • plot a graph of current against p.d.			
2	current and p.d. would not be directly proportional **or** I-V graph would not be straight **or** I-V graph would be curved		1	AO3 4.2.1.4 RPA4
	(because) resistance of **R** would increase		1	
3	0.2 (A)		1	AO3 4.2.2 RPA4
4	any **one** from: • less chance of misreading • no parallax error	allow position of eye(s) does not affect reading	1	AO3 4.2.2 RPA4
	• it can give a reading closer to the true value	allow 'it is more accurate' ignore 'no human error' ignore 'easier to read'		
Total			**10**	

15.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	$E = \frac{1.25\times10^{18}}{3.16\times10^{7}}$		1	AO2 4.1.1.4
	$E = 3.96 \times 10^{10}$ (J)	an answer that rounds to 3.96×10^{10} (J) scores **1** mark	1	
2	t = 86 400 (s)		1	AO2 4.2.1.2
	27 000 = I × 86 400	allow a correct substitution of an incorrectly/not converted value of t	1	
	$I = \frac{27\,000}{86\,400}$	allow a correct rearrangement using an incorrectly/not converted value of t	1	
	I = 0.3125 (A)	allow a correct calculation using an incorrectly/not converted value of t allow a correctly calculated answer rounded to 2 or 3 sf	1	
3	$0.15 = \frac{\text{useful power output}}{7800}$	allow a correct substitution of an incorrectly/not converted value of total power input	1	AO2 4.1.2.2
	useful power output = 0.15 × 7800	allow a correct rearrangement using an incorrectly/not converted value of total power input	1	
	useful power output = 1170 (W)	this answer only but allow 1200 (W) if correct working shown	1	
4	a really large area of land would need to be covered with solar cells		1	AO2 4.1.3
	due to the low useful power output of the solar cells	allow due to the low efficiency of the solar cells	1	

		or number of hours of daylight is too low (in UK) **or** low solar intensity (in UK) **or** solar radiation (in UK) is too low **or** material for construction of solar cells and/or lithium batteries is in limited supply		
Total			**11**	

16.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	I = 0.08 (A)	an incorrect value of I from the graph can score all subsequent marks	1	AO2 4.2.4.1
	$0.230 = 0.08 \times V$	allow a correct substitution of an incorrectly/not converted value of P	1	
	$V = \frac{0.230}{0.08}$	allow a correct rearrangement using an incorrectly/not converted value of P	1	
	V = 2.875 (V)	allow a correct calculation using an incorrectly/not converted value of P	1	
	OR			
	I = 0.08 (A) (1)			
	V = 0.08 × 36 (2)			
	V = 2.88 (V) (1)			
	OR			
	$0.230 = I^2 \times 36$ (1)			
	I = 0.08 (A) (1)			
	V = 0.08 × 36 (1)			
	V = 2.88 (V) (1)			
2	the product of current and resistance = a constant		1	AO2
	calculation of constant (2.88) using three or more pairs of values	if no other marks scored allow for one mark a statement that doubling one quantity (R or I) halves the other quantity	1	AO3 4.2.1.3

3	current would be (almost) zero (in the variable resistor)		1	AO1
	(because) the switch has (effectively) zero resistance **or** the potential difference across the variable resistor is (effectively) zero	the switch's resistance is much lower than the variable resistor allow the switch creates a short circuit	1	AO2 4.2.2 4.2.1.3
Total			**8**	

17.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	(very high p.d. means) very low currents		1	AO1 4.2.4.3
	which means less (thermal) energy is transferred to surroundings	allow less power loss in cables	1	
	which increases the efficiency of power transmission		1	
2	electric field strength is very high		1	AO1 4.2.5.2
	causing the air to become ionised	allow the air breaks down allow the air becomes a conductor allow the air conducts charge	1	
	(the kite / string) conducts charge to the person / earth	ignore answers referring to the kite touching the power cables	1	
3	straight line passing through the origin		1	AO3 4.2.5.2
	line drawn below existing line for all values		1	
4	the potential difference across the wires/cable is the same		1	AO1 4.2.2 4.2.1.4
	(but) the resistance of the steel wire is greater (and so less current in the steel)		1	
Total			**10**	

18.

Question	Answers	Mark	AO / Spec. Ref.
1	**Level 3**: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.3.1.1 RPA5
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content: • measure mass using a balance / scales • part fill a measuring cylinder with water and measure initial volume • place rock in water and measure final volume • volume of rock = final volume − initial volume • fill a displacement / eureka can with water level with spout • place rock in water and collect displaced water • measuring cylinder used to determine volume of displaced water • volume of rock = volume of displaced water • use mass and volume to calculate density • use of: density = $\frac{\text{mass}}{\text{volume}}$		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	maximum density = 2.65 (g/cm^3) minimum density = 2.45 (g/cm^3)	both required	1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	chalk or flint		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	a mean can be calculated which reduces the effect of random errors	 allow anomalies can be identified / removed	1 1	AO3 4.3.1.1 RPA5

Total Question			10

19.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	$P = V \times I$		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	$4.4 = 40 \times I$ $I = \frac{4.4}{40}$ $I = 0.11$ (A)		1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	$0.85 = \frac{P}{4.0}$ $P = 0.85 \times 4.0$ $P = 3.4$ (W)		1 1 1	AO2 4.1.2.2

Total Question			8

20.

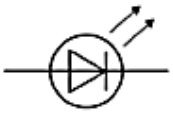
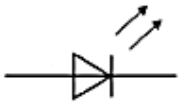
Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	transformer **X** increases potential difference		1	AO1 4.2.4.3
	and decreases current	do not accept if student states that potential difference decreases	1	
	reducing (thermal) energy transfer to surroundings **or** reducing (thermal) energy transfer from transmission cables	do not accept no energy transfer to surroundings	1	
	increasing the efficiency (of power transmission)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	transformer **Y** decreases the potential difference		1	AO1 4.2.4.3
	to a safe / safer value	dependent on scoring 1st marking point	1	

Question	Answers	Extra information	Mark	AO / Spec. Re
3	$3.24 \times 10^{11} = Q \times 230$		1	AO2 4.2.4.2
	$Q = \frac{3.24 \times 10^{11}}{230}$		1	
	$Q = 1\,408\,695\,652$ (C)		1	
	$Q = 1.41 \times 10^{9}$ (C) **or** $Q = 1\,410\,000\,000$ (C)	allow correct rounding of an incorrect answer using data from the question	1	

Total Question			10

21.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1		allow: 	1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	there is a gap in the circuit **or** S_1 needs to be closed to complete the circuit **or** S_1 needs to be closed to turn the hair straighteners on		1	AO1 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	$E = 3600$ (J)		1	AO2 4.2.4.2
	$3600 = 120 \times t$	this mark may score if E is incorrectly / not converted	1	
	$t = \frac{3600}{120}$	this mark may score if E is incorrectly / not converted	1	
	$t = 30$ (s)	allow an answer consistent with their value of E	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	the total resistance of the circuit decreases		1	AO1 4.2.4.1 4.2.2
	so the current increases		1	
	which increases the power output		1	
Total Question			**9**	

22.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	increase	must be in this order	1	AO1 4.2.4.3
	decrease		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	$P = I^2R$		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	$1.60 \times 10^9 = 2000^2 \times R$		1	AO2 4.2.4.1
	$R = \frac{1.60 \times 10^9}{2000^2}$		1	
	$R = 400\ (\Omega)$		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$ **or** efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$		1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5	$0.992 = \frac{\text{useful energy output}}{34.2}$		1	AO2 4.1.2.2
	useful energy output $= 0.992 \times 34.2$		1	
	useful energy output $= 33.9$ (GJ)	allow a correct answer given to more than 3 s.f.	1	

Total Question		10

23.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	polarity of the potential difference doesn't change	allow direction of the potential difference doesn't change	1	AO1 4.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	$E = QV$		1	AO1 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	$5010 = Q \times 12$		1	AO2 4.2.4.2
	$Q = \frac{5010}{12}$		1	
	$Q = 417.5$ (C)	allow 418 (C)	1	

24.

Question	Answers	Mark	AO / Spec. Ref.
1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.2.1.4 RPA4
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • ammeter in series with filament lamp • current measured with an ammeter • voltmeter in parallel with filament lamp • p.d. measured with a voltmeter • variable resistor (or variable power pack or variable number of cells) used to vary current in and p.d. across filament lamp • range of p.d. of 0 to 6 V • interval of p.d. of 1 V • reverse connections to power supply to obtain negative values • take repeat readings and calculate a mean • discard anomalies Indicative content may be seen in a circuit diagram. Level 3 answer: needs to include a circuit which would work (if included) and a method to obtain negative values.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	$3.0 = 0.16 \times R$	allow a correct substitution of an incorrect value of I in the range 0.15 (A) to 0.17 (A)	1	AO2 4.2.1.3
	$R = \frac{3.0}{0.16}$	allow a correct rearrangement of an incorrect value of I in the range 0.15 (A) to 0.17 (A)	1	
	$R = 18.75\ (\Omega)$	allow 19 (Ω) allow 18.8	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	$t = 1800$ (s)		1	AO2 4.2.4.2
	$Q = 0.21 \times 1800$	all subsequent marks can score if an incorrectly / not converted value of t is used	1	4.1.1.4 4.2.1.2 4.2.4.1
	$Q = 378$ (C)		1	
	$E = 378 \times 6.0$		1	
	$E = 2268$ (J)	allow an answer to 2 or 3 s.f.	1	
	OR			
	$P = 0.21 \times 6.0$ (1)			
	$P = 1.26$ (W) (1)			
	$t = 1800$ (s) (1)	all subsequent marks can score if an incorrectly / not converted value of t is used		
	$E = 1.26 \times 1800$ (1)			
	$E = 2268$ (J) (1)	allow an answer to 2 or 3 s.f.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	(for the power to quadruple) the current and the p.d. would both need to double		1	AO3 4.2.1.4 4.2.4.1
	(but the current doesn't double) because the resistance of the filament lamp increases **or** (but the current doesn't double because the graph shows that) current is not proportional to p.d.	allow the graph does not show direct proportionality ignore the graph is not a straight line ignore the graph is not linear	1	
Total Question			**16**	